INVESTIGATOR'S ANNUAL REPORT

National Park Service

All or some of the information provided may be available to the public

Reporting Year: 1994	**Park:** Shenandoah NP
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Permit#:
SHEN1994AJLI

Park-assigned Study Id. #:
unknown

Project Title:
Differences in Soil Sulfate Adsorption within a Headwater Catchment in Shenandoah National Park, Virginia

Permit Start Date: Jan 01, 1998	**Permit Expiration Date** Jan 01, 1998
Study Start Date: Jan 01, 1991	**Study End Date** Jan 01, 1994

Study Status:
Completed

Activity Type:
Other

Subject/Discipline:
Water / Hydrology

Objectives:

To determine if observed streamwater sulfate differences can be explained by differences in soil adsorption and physicochemical properties. ; ;Adsorption of sulfate by soils is considered the dominant mechanism for delaying streamwater acidification in the Blue Ridge Mountains of western Virginia. Sulfate in acidic deposition is the primary contributor of acidity to sensitive surface waters. On a regional basis, streamwater sulfate concentrations previously have been correlated with bedrock type in attempts to identify potentially sensitive surface waters. However, significant variability in streamwater alkalinity and sulfate concentrations occurs within given bedrock types, indicating that soil chemical behavior might influence streamwater chemistry more than bedrock type. One focus of the Shenandoah Watershed Study (SWAS) is to characterize and model streamwater response to high levels of acidic deposition. Catchments in Shenandoah National Park (SHEN) retain approximately 60% of sulfate inputs (fluxes of sulfate in combined wet/dry deposition range from 750 to 1500 eq/ha/yr; streamwater sulfate fluxes range from 100 to 1000 eq/ha/yr) and the sulfate adsorption capacity of these soils apparently has not yet been reached.;The four principal objectives of this research were: 1) to determine if the soils in a SHEN headwater catchment adsorb sulfate and if the amount adsorbed increases with increasing concentrations in the soil solution; 2) to assess whether soil sulfate adsorption behavior may explain observed differences in streamwater sulfate concentrations in the two adjacent subcatchments; 3) to establish whether differences consistent with adsorption behavior may be observed for certain easily-measured soil physicochemical properties; and 4) to construct an empirical model of adsorption behavior to aid in understanding the chemical interactions influencing the adsorption process.

Findings and Status:

A significant difference in net adsorption exists between the two subcatchments and between the amounts of sulfate adsorbed at several addition levels. These net adsorbed sulfate data also indicate that the soils may best be grouped into two soil assemblages; this redefinition of the soils by soil assemblage implies that variations in soil chemical characteristics, rather than bedrock type, may be the primary control on catchment streamwater chemistry. Differences in the physicochemical properties between subcatchments are significant only for pH, moisture content, and percent clay. Differences in physicochemical properties between the identified soil assemblages are significant only for pH, organic matter content, and percent clay. ;Isotherm and regression mofels lack predictive power, but allow certain chemical characteristics of the Shaver Hollow system to be understood. First, producing isotherm fits effectively "smooths out" the differences between subcatchments observed in the net adsorbed sulfate data. Second, a model of physicochemical properties and adsorption based on principal components analysis and stepwise multivariate regression accounts for approximately

70% of the variance, but the range of the data is inadequate to construct a truly robust model of soil behavior applicable to other watersheds.;The results of this research indicate that 1) variability in adsorption and physicochemical properties may be high throughout a given catchment (even those underlain by a relatively homogenous bedrock) and, 2) constructing isotherms "smooths out" soil characteristics otherwise observable in raw data. These results have improrant ramifications for the application of lumped water quality models: characterizing soil chemical behavior with only one adsorption isotherm to represent the adsorption behavior of an entire catchment may not be adequate to model adsorption's effects on streamwater chemistry.

For this study, were one or more specimens collected and removed from the park but not destroyed during analyses?

No

Funding provided this reporting year by NPS:	**Funding provided this reporting year by other sources:**
0	1300

Fill out the following ONLY IF the National Park Service supported this project in this reporting year by providing money to a university or college

Full name of college or university:	**Annual funding provided by NPS to university or college this reporting year:**
UNIVERSITY OF VIRGINIA	700